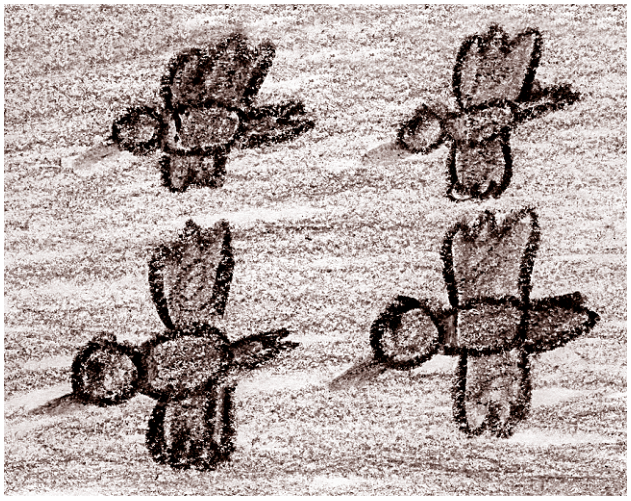
Fall Changes



MOLLY JONES

Outline

Theme

Animals and plants prepare for winter in a variety of ways.

Utah State Science Core Curriculum

Topic: Changes in Plants and Animals
Standard [3020-01]
Students will:

- Compare changes and adaptations of plants and animals.
- Identify and compare changes plants and animals make that are related to the seasons.
- Observe and describe how plants and animals change during their lives.

Suggested Field Trip Locations

Big Bend Picnic Area and adjacent Colorado River beach, on Highway 128 near Moab, or another area with several oaks and other trees and a large north-south open area for Station #1. The peak of fall colors at the 4000-foot elevation of Moab is usually during the first week of November. Higher elevations peak earlier.

Background

Each fall, many birds migrate to the south or to lower elevations for the winter. Migration is primarily an adaptation to insufficient food supplies, and can also be an adaptation to cold temperatures. Migration is primarily a behavioral adaptation, though birds have physical adaptations that help them to migrate. In the fall, hormones generated by shorter days induce birds to eat, store up fat, and become restless. Once migrating, birds may find their way using the sun, stars, moon, or magnetic compasses in their heads. Immature birds may learn landmarks, such as rivers or mountain ranges, while flying with a flock. Not all birds use all of these methods; different species specialize in different navigation techniques. Sometimes flocks of many species fly together, possibly to take advantage of multiple navigation techniques.

DAMIAN FAGAN

Skimmer dragonfly

Canada geese mate for life, and migrate together in family groups. Geese whose mates have been killed by hunters have been known to fly in circles above their dead mates, honking. Eventually, though, they find replacement mates. Geese normally migrate by cruising up to 35 miles per hour, in a V-shaped or J-shaped flock. The father or eldest offspring, usually the largest goose, goes in front, possibly blocking out some of the wind. These formations may serve simply to keep groups together and within sight of each other, and help them avoid mid-air collisions.

Insects aren't seen much in the winter, yet in order for each species to survive, some of its members must live through the winter in some form. Many insects find shelter and cease activity during the winter. Most have just one life stage adapted to the cold, drought and lack of food that generally coincides with the pause. (See background of 2nd Spring Changes for more information on insect life cycles.) Most aphids, crickets, grasshoppers, and mantises, gypsy moths, and some dragonflies overwinter as eggs. Woolly bear caterpillars, cicadas, and some beetles overwinter as larvae. Some dragonflies and stoneflies spend the winter as nymphs. Swallowtail butterflies and Cecropia moths overwinter as pupa. Ants, honeybees, queen bumblebees, Monarch and Mourning Cloak butterflies, and ladybugs overwinter as adults. Monarchs are known for their long winter migrations. Most other insects find shelter under tree bark, under leaf litter, burrowed into soil, or in the bottom of ponds (Lingelbach 1986).

Many plants lose their leaves during winter. Freezing temperatures result in less water available for photosynthesis. Further, a leafless plant is more streamlined and less likely to break with the weight of heavy snows. The process leading up to this winter change results in beautiful fall colors. Plants have different naturally occurring pigments in their leaves, which are masked by the stronger *chlorophyll* pigment for most of the year. As fall progresses, plants stop producing chlorophyll, and the other pigments show themselves. Leaves with *xanthophyll* pigment turn yellow; *carotene* pigments produce orange and red colors. As days shorten, plants produce a corky *abscission* layer at the leaf scar. Leftover sugars in some plants' leaves, now isolated from the plants' vascular systems, are converted to yet another pigment called *anthosyanin*, which produces a bright red leaf color. This conversion is aided by sunlight.

There are 400 to 500 species of oaks in the world, 68 of them in the United States, and three in the national parks of southeastern Utah. They hybridize, so differentiating species can be difficult. Humans have a long history of using oak wood, which is strong and dense, and acorns, which can be ground, leached and used as flour, or roasted and used as a coffee substitute. A few animals eat the leaves of oaks, including mule deer and porcupines. Many animals eat acorns, including squirrels, jays, grouse, wild turkeys, woodpeckers, several songbirds, black bears, and numerous insects. Gall-forming insects use oaks more than any other group of plants.

PRE-TRIP ACTIVITY

Preparing for winter: now and then

NOTE

Locate and schedule a guest senior citizen in advance who is willing to speak to the class for 15 or 20 minutes about experiences as a child. Ask the guest to focus especially on the family's preparations for winter, and the child's role in the preparations. The most appropriate guest for this activity would be one who lived rurally as a child and whose family grew and stored much of their own food.

PROCEDURE

1) With students, make a list of things that they or their families do to prepare for winter. Include taking the winter clothes out of boxes, buying new shoes or jackets, harvesting vegetable gardens, canning or freezing foods from the garden or from fruit trees, hunting and storing meat, draining and winterizing swamp coolers, draining garden hoses, making sure the car has enough antifreeze, and perhaps putting on snow tires or carrying tire chains in the car. Explain that plants have to be harvested because the water in them freezes in the winter and the plants either become dormant or die. Reinforce that all water that is outside in the winter will freeze.

2) Introduce senior guest speaker. Allow guest to speak, and students to ask questions.

3) Explain that on the upcoming field trip students will explore how animals other than humans prepare for winter, and how they survive the winter. Reinforce what students should bring to school for the field trip by having students raise hands and take turns listing the items. Emphasize the need to bring warm clothes.

Objectives

Students will be able to:

- Explain at least three differences in how humans prepare for winter now versus how they prepared for winter 50 or 70 years ago.

Materials

- Guest senior citizen

Time

- 30 minutes

PRE-TRIP

Objectives

Students will be able to:
- Name one reason that birds migrate.
- Describe two dangers of Canada geese migration.

Materials

- Picture of Canada geese
- Directional signs (two pieces of cardboard, cut in the center so they intersect)
- **Migration Clue Cards**

Time

- 30 minutes

STATION ONE

Canada geese migration

NOTE

Hide clue cards in advance, along a 150-yard course. Set up the directional signpost in a prominent place which students will be able to see during the activity.

PROCEDURE

1) Talk with students about migration as an animal adaptation. Emphasize Canada geese and how they migrate, showing pictures of geese. Talk about the benefits and dangers of migration. Include natural dangers such as high winds, storms, not being able to find food, and dangers caused by people such as hunting, transmission lines, and loss of habitat. Mention the Matheson Wetlands Preserve between Moab and the Colorado River as a good place for geese to stop while they are migrating. Explain that if we were to build everywhere near water, the birds wouldn't have anywhere to stop and eat.

2) Briefly discuss directions enough that students understand that it's warmer in the south. Point out the directional signpost.

3) Tell students that they will be migrating together as a gaggle of geese, following a set of clue cards. Set up a standard of cooperation, asking students to take turns finding clues, and to stay together. Read the first clue to the students. Lead them in "flying" in a V formation. Have students read each clue together. Ask alternating finder to replace each clue.

4) Add interesting facts about migration or geese as you go through the course with the students. When the course is complete, review reasons for migrating, dangers of migrating, and/or adaptations that geese have to help them migrate.

EVALUATION

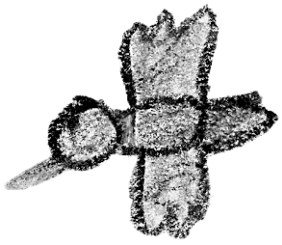
Have students draw a picture map of a Canada goose migration, showing the events and dangers that a goose might encounter along the way.

STATION 1

MIGRATION CLUE CARDS

Copy onto tagboard and cut apart along lines.

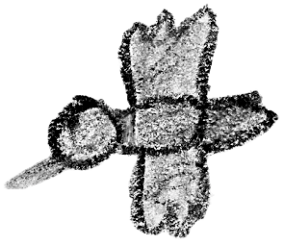
1.



You are starting on your migration south to your winter home. The weather is perfect.

Flap 7 times south.

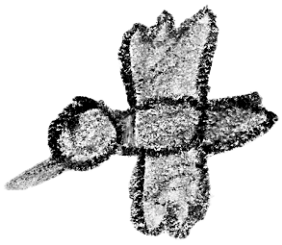
2.



The days are beautiful for flying. The winds are helping you fly.

Flap 11 times south.

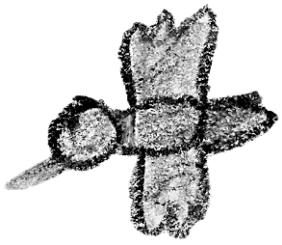
3.



You stopped overnight in a marsh for a rest. You are ready to fly again.

Flap 10 times east.

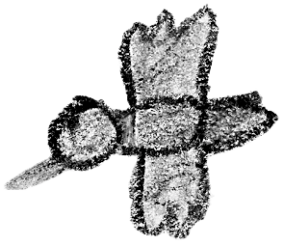
4.



After stopping for lunch in a farmer's field, you continue flying south.

Flap 9 times south.

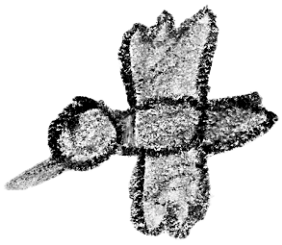
5.



You hear thunder. A storm is coming!

Flap 14 times south.

6.



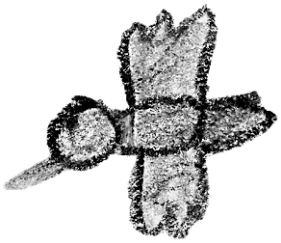
The winds are strong. Flap hard to stay on course.

Flap 8 times west.

MIGRATION CLUE CARDS

Copy onto tagboard and cut apart along lines.

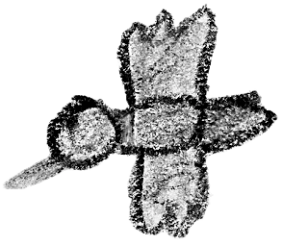
7.



The storm is over.
It is perfect for flying.

Flap 17 times south.

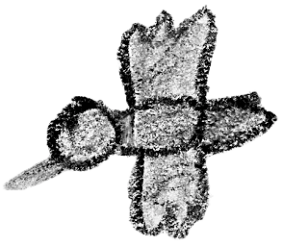
8.



You hear the sound of hunters.
Take cover!

Flap 7 times east.

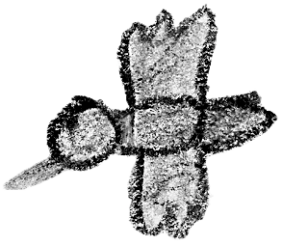
9.



You fly quietly over the trees,
without making a single noise.

Flap 11 times west.

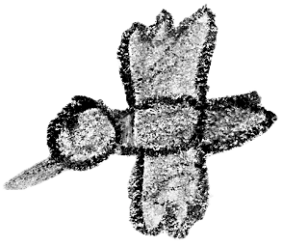
10.



There are no more strange sounds.
Time to fly away.

Flap 13 times south.

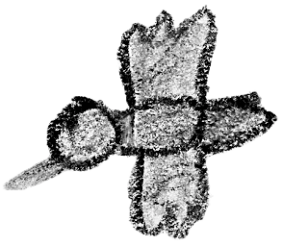
11.



Your winter home is in sight.
Honk because you are happy!

Flap 21 times south.

12.



Welcome to your winter home
in the south! Eat some plants and
leave some for the rest of the geese!

STATION TWO

Where have all the insects gone?

PROCEDURE

1) Discuss insects that students have seen in their schoolyard or at home recently. Briefly discuss the four stages of complete metamorphosis. Ask students if they know where insects go in the winter. Tell them that you have a puppet show that will provide some answers.

2) Ask a parent or student to act out the boy's part at the beginning of the show (before the puppets appear in the show). Perform the **Insects in Winter Puppet Show**. Discuss.

3) Pass out one **Wintering Insect Card** to each student. Have students take turns holding up their cards for the group to read.

4) Go on a hike with students to look for real insects. Look for insects that are out, as well as insects that might be hidden under rocks, leaves, or bark. If there is a stream nearby, look for insects wintering in the water.

OBJECTIVES

Students will be able to:
- Describe where and in what stage at least one type of insect spends its winter.
- Look for insects in likely wintering places.

MATERIALS

- **Insects in Winter Puppet Show** (Lingelbach 1986, 142-143)
- Puppets and props for puppet show
- **Wintering Insect Cards**

TIME

- 30 minutes

STATION 2

Insects in Winter Puppet Show

Reprinted with permission from Hands-On Nature: Information and Activities for Exploring the Environment with Children, *1986. Edited by Jennepher Lingelbach. Vermont Institute of Natural Science, Woodstock, VT 05091.*

Live characters: Dad
Boy

Puppet Characters: Boy in miniature
Woolly Bear Caterpillar
Cecropia Moth Cocoon ("Ceci")
Ladybug
Tent Caterpillar egg case on twig

SCRIPT

Boy ..... Dad, where have all the insects gone?

Dad ..... Well, I don't know. I suppose they flew away.

Boy ..... Where did they fly to?

Dad ..... I don't know. I read somewhere that monarch butterflies go to Mexico for the winter. And speaking of going somewhere, it's time for you to go to bed. Tomorrow we'll find out where the insects went.

Boy ..... (Yawning.) Aw, gee whiz. Ok dad, I am sleepy. (Both leave.)

— — — — PUPPET SHOW BEGINS HERE — — — —

Boy ..... (Smaller version of boy appears.) Where am I? Everything looks so big. What is that? It looks like a rolled up rug with feet, and it's coming towards me. (Woolly Bear appears.)

Woolly Bear ... Hello, young man. Did I hear you ask where the insects were?

Boy ..... Um, er, yes, but what, or should I say who, are you?

Woolly Bear ... I am Isabella.

Boy ..... Isabella? You look like a woolly bear. But you're awfully big.

Woolly Bear ... On the contrary, my friend. You are awfully small. But it's just as well, because if you'll get on my back, I can take you around to visit some insects. Then you'll know where they go in winter.

Boy ..... Thank you, Woolly Bear. I've never ridden bear back. (He gets on her back.) You're pretty scratchy. Couldn't you get a haircut?

Woolly Bear ... My hair, as you call it, is what keeps me warm in the winter. That's why you find me curled up in woodpiles, or even, occasionally, walking across the snow.

Boy ..... Why did you say your name was Isabella when we all know your name is Woolly Bear?

Woolly Bear ... I am a woolly bear caterpillar now, but I won't always be. Do you know about the life stages of an insect?

Boy ..... Yup, I learned them; egg, larva, pupa, adult for some kinds; egg, nymph, adult for other kinds.

Woolly Bear ... My, my, little boy. You are up on your insects. Let's see if the audience knows what stage I'm in. Audience, what do you think? (Pause.)Yes, the larval stage. After I pupate in the spring, I will become an Isabella moth, so my name will be Isabella. Oh, here's a relative I'd like you to meet. Hi, Ceci.

Boy ..... What do you mean, "Hi Ceci?" That's an old dead leaf.

Woolly Bear ... That's what you're supposed to think, camouflage you know. Hi, Ceci. (Cecropia cocoon appears.)

Ceci ..... (Talk with hand over mouth to muffle sound.) Hi.

Woolly Bear ... What did you say?

Ceci ..... (Muffled:) I said "hi." Stop bothering me, I'm resting.

Woolly Bear ... I wanted you to meet my new young friend. He wonders where all the insects have gone.

Ceci ..... (Still muffled:) Well this one has gone to sleep. If you have trouble hearing me, it's no wonder. I'm wrapped up inside two layers, the one you're looking at and a smaller case inside that one. Keeps me warm and dry.

Boy ..... I know what stage he's in. It's, it's, it's. . .help me audience, I forgot the name. (Hopefully they say pupa.) Oh yes, the pupal stage.

Woolly Bear ... That's right, Ceci will become a Cecropia moth. Well, goodbye Ceci. Guess the next time we meet, we'll both be moths. Have a good winter. (Pupa goes down: tent caterpillar case comes up.)

Boy ..... Hey Woolly, what's that big barrel around that branch?

Woolly Bear ... That's no barrel. Some cousins of mine live there. Maybe the audience can guess what stage they're in. What do you think boys and girls? (Pause - egg stage.) You got it! They won't hatch until the new leaves grow on that twig next spring.

Boy ..... Hatch? Sounds like baby birds.

Woolly Bear ... Well, same idea. Baby birds hatch at the time of year when there's food for them. And baby insects hatch when they too can find food.

Boy ..... What will they hatch into?

Woolly Bear ... Caterpillars. They're called tent caterpillars because they make themselves a silk tent to live in when they're not off eating.

Boy ..... I thought spiders spun silk.

Woolly Bear ... They do, but they're not the only ones. Tent caterpillars also leave trails of silk behind them when they travel to new branches so they can find their way home. (Twig goes down.)

Boy ..... That's neat. Then they never get lost. Where are we going now?

Woolly Bear ... I'm looking for a certain big pile of leaves near this cornfield.

Boy ..... Is that it over there, right next to that big old tree?

Woolly Bear ... Yes. You have sharp eyes, my friend. We'll go make a call.

Boy ..... Every time we talk to someone it's either inside, on, or under a bunch of leaves, or a twig. No wonder I never saw insects in winter, except sometimes I've seen you, Woolly.

Woolly Bear ... Hello, hello in there. Anyone awake on this gorgeous sunny day? (Ladybug appears.)

Ladybug ..... Well, bless my soul. It is nice out, but it's hardly time for us to wake up. What time is it anyway?

Woolly Bear ... It's wintertime, lady. I'm sorry to interrupt your long winter nap, but I wanted to introduce my friend here to an insect in its adult stage. He wondered where insects went in winter.

Ladybug ..... We ladybugs go to sleep. It's very cozy all bunched up together under a nice big pile of leaves. Makes good insulation, especially if there's snow on top of them. No point staying awake when there's nothing to eat. It's not like I can fly to the nearest Dunkin Donuts, you know.

Boy ..... Excuse me lady. What *do* you eat?

Ladybug ..... Little insects called aphids. Delicious, sweet, yet full of protein. You ought to try them sometime. (Yawn.) I'm getting tired, got to save my strength until aphid season. Think I'll go back to sleep. Bye. (Leaves.)

Boy ..... Sleep! That's it! I'm asleep and this is a dream. I can't wait to wake up and tell my dad what I've found out. Thanks, Woolly. I think I'll get off you now and go home. You have a good winter, and if I see you next spring, I'll call you Isabella. Ok? Bye.

Woolly Bear ... Bye.

WINTERING INSECT CARDS

Copy onto tagboard and cut apart along dashed lines.

ANTS winter as adults, deep in their anthills or in trees or logs.	Adult MONARCH BUTTERFLIES migrate to Mexico or California for the winter.
PRAYING MANTISES spend the winter as eggs in a hard brown case.	Some BEETLES spend winter as larvae down in the soil.
Most CRICKETS and GRASSHOPPERS survive winter as eggs buried underground.	CADDIS FLY LARVAE crawl around on the bottom of streams or ponds all winter.

STATION THREE

A rainbow of leaves

PROCEDURE

1) Show students the leaf cutout with green overlay showing. Inform students that a green chemical called *chlorophyll* helps leaves use sunlight to make food for plants. Discuss why trees lose their leaves in the winter.

2) Ask students to predict how many different colors of leaves they think they can find right around the area. Ask them to spend a few minutes collecting as many different colors of leaves as they can find. Give boundaries and assist students in their hunt. Have students sit in a circle with their leaves in front of them. Discuss the main colors of the leaves found, and start a pile for each color. Have students take turns sorting their leaves into the piles by color.

3) Ask students what color their eyes are, and tell them that the different colors of eyes, hair, or flowers are due to different substances called *pigments*. Show the cutout leaf, with green overlay. Explain that leaves are green because the chlorophyll that helps plants make food has a strong green pigment. Explain that plants quit making chlorophyll in the fall, and other pigments in the leaves show up as the chlorophyll runs out. Flip the green overlay over to reveal the yellow leaf underneath. Explain that different types of leaves have different pigments, and that some leaves turn orange or light red. Pick up a leaf and break the leaf petiole in half. Compare the ragged break that results to the end of the leaf petiole on another leaf. Have students each pick up a nearby leaf and look at the end of the leaf petiole, and notice how smooth the break is. Explain that there is a layer between the leaf and stem called the *abscission layer*, which becomes weak when the days get short in the fall. Explain that when this happens the tubes that transport food and water through the plant become blocked; no more water or food can go in or out of the leaf to the rest of the tree. In some types of trees with lots of sugars in their leaves, the trapped sugars turn the leaves bright red. Turn next overlay on leaf cutout to reveal bright red leaf with a labeled *abscission layer*. Explain that eventually the leaf falls off, breaking at the abscission layer. Discuss some of nature's uses and human uses of fallen leaves, including ground insulation, wintering places for insects, fertilizer for next year's plants, and composting.

4) Lead students on a walk looking at different colored leaves, which trees are still green versus those that have lost leaves, and the movement of different shaped leaves as they fall from the trees. Follow student interests. See which types or shapes of leaves fall slowest, or maintain safety during a big leaf pileup and jumping session.

Objectives

Students will be able to:
- Name one reason that many plants lose their leaves for the winter.
- Collect several leaves and categorize them according to color.

Materials

- Large posterboard leaf cut-out, with overlays. (Top overlay should be green; next overlay should be yellow; and bottom leaf should be bright red and should have a mark across the leaf petiole, labeled *abscission layer*.)

Time

- 30 minutes

STATION 3

Objectives

Students will be able to:
- Gather and record scientific evidence based on observation.
- Describe how at least three animals use oaks or acorns.

Materials

- Knife or pre-cut acorn
- Clipboards
- Pencils
- Paper
- Tape
- Large sheet of paper
- Marker
- (optional) Book with pictures of oaks and acorns from different areas

Time

- 30 minutes

STATION FOUR

Exploring oaks and their acorns

PROCEDURE

1) Show students an acorn. Model the difference between an observation and an opinion, by making several observations and giving a couple of opinions about a backpack or hat. Have a couple of volunteer students make observations about the object. Then pass around the acorn and have each student make one observation about it. Cut open the acorn, discuss its contents, and have each student make one more observation. Ask students if they know the source of the acorn. Walk over to a nearby oak tree and have students look on and under it briefly to see if they can find other acorns. Have each student make one observation about the oak tree.

2) Have students sit again. If you wish, show them pictures of some of the different types of oak trees and acorns from different areas. Then explain that they are going to explore the question: *As a group investigating acorns and oaks, how many different kinds of animals can we find evidence of?* Have students make predictions and discuss the animals they can think of that use acorns or oaks, and where they would look for evidence. Be sure the students include insects in their discussion. Divide students into pairs, and distribute clipboard, pencil and paper to each pair. Ask students to look for evidence, and to draw a picture or print a word or two to remember each form of evidence that they found. Alternatively, if they find evidence in a dead leaf, they may tape the leaf to their sheet.

3) Help the students find evidence. Carry tape. Look for different types of insect galls, insect chew marks on leaves, insect holes in acorns, browsed branches, and squirrel caches.

4) Gather students and discuss findings. Examine any taped-on leaves, and briefly discuss insect galls. (See background of 2nd Spring Changes field trip.) On a large sheet of paper, compile the group's results by making a list of evidence of different animals. Ask each pair to present the finding that surprised them most, or that they found most interesting. Inform students that we have just completed a scientific investigation and that we might conclude that acorns are important to many animals. Tell them that people who lived here before grocery stores also made use of acorns. Discuss how ancestral native groups of people prepared acorns to eat.

STATION 4

POST-TRIP ACTIVITY

Winter animal charades

PROCEDURE

1) Review why and how leaves change color and how they fall. Discuss how oaks change in the fall. With student input, generate a list on the board of animals mentioned on the field trip. Discuss how each prepares or spends its winter. Include oak-users, a variety of insects, and migrating birds. Discuss a few others and add them to the list, including deer and elk that migrate to lower elevations when snow gets deep in the mountains.

2) Divide students into groups of three or four. Have each group secretly choose one animal from the list and plan a charade of the animal. The charade should depict the animal either preparing for winter or in its wintering state. Explain that no talking is allowed during the charade.

3) Have each group perform its charade. Have other students raise hands as soon as they figure out the charade. Review or add information about each animal.

4) Read *Owl Moon* to the class.

OBJECTIVES

Students will be able to:
- Describe how at least three animals prepare for winter or spend the winter.
- Dramatize one of the animals preparing for winter or in its wintering state.

MATERIALS

- *Owl Moon* (Yolen 1987)

TIME

- 30 minutes

POST-TRIP

References and Resources

Ehrlich, Paul R., David S. Dobkin, and Darryl Wheye. 1988. *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*. New York, NY: Simon and Schuster/Fireside Books.

Lingelbach, Jenepher, ed. 1986. *Hands-On-Nature: Information and Activities for Exploring the Environment with Children*. Woodstock, VT: Vermont Institute of Natural Science.

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Yolen, Jane. 1987. *Owl Moon*. Illustrated by John Schoenherr. New York: Philomel Books.

Rocks

ASHLEE R. HASS

Outline

Theme
Rocks in our area give us a glimpse into the dynamic rock cycle.

Utah State Science Core Curriculum
Topic: Rocks
Standard [3020-06]
Students will:
- Investigate changes in rocks.
- Examine and discuss observable characteristics of rocks.
- Observe and list how rocks change due to elements in the environment.

Suggested Field Trip Locations
Any of the many sandstone slickrock areas of southeastern Utah. Sand Flats Recreation Area east of Moab is an excellent location. On the other hand, any outdoor location could be used for Stations #1 and #4, and any location with sandstone could be used for Station #2. A location with cryptobiotic soil is needed for Station #3.

Background

Rocks are made up of one or more minerals. Minerals are naturally occurring elements (e.g., gold) or inorganic compounds (e.g., quartz). Each mineral has a specific crystal structure.

Practicing the Sandstone Recipe Rhyme *at the Sand Flats Recreation Area east of Moab.*

There are three major kinds of rocks: igneous, sedimentary, and metamorphic. Igneous rocks form from molten rock (magma) that has cooled. Examples include granite, basalt and pumice. They are usually unlayered (except basalts), and often contain visible crystals. Sedimentary rocks form when sediments are deposited by water or wind on the surface of the earth, then harden over time, as they are buried and cemented. Sedimentary rocks commonly look layered. Metamorphic rocks can start as any rock type, but are altered (not melted) by heat and/or pressure. Sandstone metamorphoses into quartzite, limestone into marble, and granite into gneiss. Crystals commonly seen in metamorphic rocks are usually oriented in lines or sheets, at times giving both small hand samples and outcrops a wavy or crinkled appearance.

Rocks change. Heat or pressure can metamorphose any type of rock. Heating to the melting point, and later recrystallization, can form a new igneous rock. Any type of rock can erode, be redeposited, and become a sedimentary rock. These processes, changing one type of rock into another, are known collectively as the rock cycle. Many simpler cycles exist within the complex rock cycle. Metamorphic rocks may be remetamorphosed. Igneous rocks may melt and recrystallize.

In this field trip we emphasize the sandstone rock cycle, in which a sandstone erodes into sand, and then after being redeposited, hardens again into sandstone. The hardening, or lithification, process occurs when the weight of overlying rocks compacts the sediments and/or when fluids percolating through the sediments deposit minerals, or cement, between the sand grains.

Most rocks in southeastern Utah are sedimentary, and the most common sedimentary rock is sandstone. Sandstone is made up of quartz sand grains cemented together by calcium carbonate or silica. The red appearance of many sandstones in the area is due to oxidized iron that coats the sand grains. Generally, sandstone is easily eroded. Water is the most effective agent of erosion, but gravity and wind also play a part. The erosion of sandstone formed the unique canyons, needles, arches, natural bridges, spires and balanced rocks of southeastern Utah.

Based on the definition of an arch as an opening at least three feet across in one direction, there are over 2,000 named arches in Arches National Park. Most are within the Entrada Formation. Water is the main culprit in arch formation. Rainwater is usually slightly acidic, which weakens the cement between grains in the sandstone. The process of frost wedging involves water freezing (expanding) and thawing (contracting) in pores and cracks. This process is key in breaking apart sand grains, and especially prevalent with the large temperature fluctuations of the high desert climate. Wind and gravity remove weathered parts. Arches can be classified by their shapes, falling into categories including free-standing arches, cliff-wall arches and jug-handle arches. Natural bridges, unlike arches, are formed by flowing streams.

Petrified wood forms when minerals (usually quartz) replace organic materials in wood. Chert is microcrystalline quartz, without the cellular structure visible in petrified wood. It is very hard and breaks like glass. Limestone is calcium carbonate, deposited on ocean floors.

Granite is found in the La Sal Mountains near Arches and Canyonlands national parks. It is a hard igneous rock that cooled from a magma while still underground. Granite is composed primarily of visible crystals of quartz, mica, and feldspar. Generally, granite erodes more slowly than sandstone. Small pebbles eroded from granite, along with organic materials from mountain vegetation, contribute to rich mountain soil.

Deserts have less, smaller, and slower-growing vegetation than mountains, so desert soils have a low organic content. Cryptobiotic soil crusts are extremely common in the southeastern Utah high desert, and help to make up for this lack of organic matter. The soil crusts are a community of small organisms that form a living mat, and secure the top few inches of sand particles against water and wind erosion. The crusts also increase absorption and retention of water, and add nitrogen to the soil, an essential for plant growth. Cryptobiotic crusts give desert soils a lumpy look, partly a result of frost heaving – upthrusts caused by the freezing of moist soil in winter. They are very fragile, and important enough that their preservation is the target of many of the educational efforts within the southeastern Utah national parks. To avoid walking on the crusts, hikers should walk on slickrock, on trails, or in washes. Don't bust the crust!

PRE-TRIP ACTIVITY

Just what are rocks anyway?

PROCEDURE

1) Tell students that they will be exploring rocks on the upcoming field trip. Inform them of the field trip location and the food, water, and gear they need to bring to school on the day of the field trip.

2) Read and discuss the book, *Rock Collecting*. Emphasize that rock underlies everything on the earth's surface. In review of the book, ask students for ways that they could classify their rocks, such as by color, hardness, or the three rock types.

3) Discuss **The Sandstone Rock Cycle** using the poster. Remind students that like a circle, this cycle never ends. Relate this to other cycles that they know about. To introduce the topic of erosion, ask students what happens to rocks when it rains.

4) Read and discuss the book, *Everybody Needs A Rock*. Inform students that we won't be collecting any rocks on this field trip, though they may wish to another time.

5) Reinforce what students should bring to school for the field trip by having students raise hands and take turns listing the items.

EVALUATION

Have students start a rock collection from rocks found in the schoolyard. Have students categorize the collected rocks by observable characteristics.

Create a whole class story on a sandstone rock that travels through the rock cycle. Record the story on chart paper.

OBJECTIVES

Students will be able to:
- Realize that rock underlies everything on the surface of the earth.
- Name one set of categories that could be used to classify a rock collection.

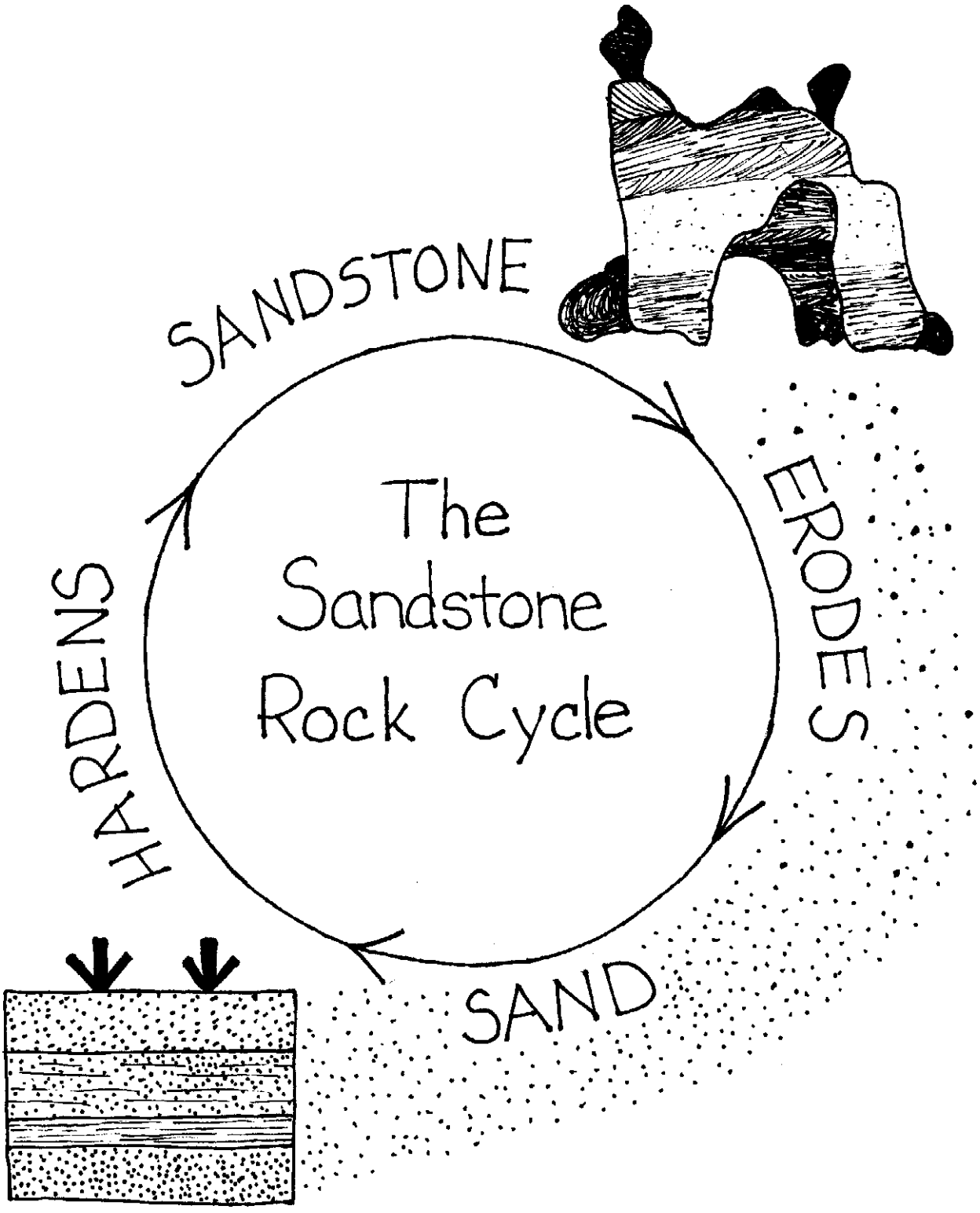
MATERIALS

- **The Sandstone Rock Cycle** (copied to poster size)
- *Rock Collecting* (Gans 1984)
- *Everybody Needs A Rock* (Baylor 1974)

TIME

- 30 minutes

PRE-TRIP


The
Sandstone
Rock Cycle
SANDSTONE
ERODES
SAND
HARDENS

INTRODUCTORY ACTIVITY

Sandstone rock cycle toss

NOTE

Separate the class into learning station groups and do this activity in small groups at the first station, allotting extra time for that station.

PROCEDURE

1) Hand out a sandstone rock cycle name tag to each student, being sure to include at least one of each of the four types of tags. Discuss the sandstone rock cycle using the poster and the students' name tags.

2) Begin the game by throwing the ball to a person with a *Sandstone* name tag. Have the "sandstone student" say the next stage of the cycle, "erodes," then throw the ball to a student who has that name tag. Continue around the cycle several times.

EVALUATION

Have students continue to play the game, saying out loud the next part of the cycle without using name tags.

Have students draw the sandstone rock cycle using the words *sandstone, erodes, sand* and *hardens*.

Objectives

Students will be able to:
- Name the four stages of the sandstone rock cycle.

Materials

For each of four groups:
- **The Sandstone Rock Cycle** poster
- Two each of the sandstone rock cycle name tags (*Sandstone, Erodes, Sand, Hardens*)
- A soft, lightweight ball

Time

- 5 - 10 minutes

INTRO

Objectives

Students will be able to:

- Identify and describe, using observable characteristics, three specific kinds of rocks found in the area.

Materials

- **The Sandstone Rock Cycle** poster that highlights *sandstone*
- Blindfolds
- Rock samples (e.g., sandstone, granite, limestone, chert, and petrified wood)

Time

- 30 minutes

STATION ONE

Rocks, rocks and more rocks

PROCEDURE

1) Show and discuss **The Sandstone Rock Cycle** poster. Explain to students that although sandstone is the most common rock found in our area, there are other kinds of rocks as well.

2) Hand out rock samples. Ask students which rock they think is the hardest, softest, and heaviest. Ask which rock is the same kind as that on which they are sitting. Discuss each rock, including its name and where it was collected.

3) Pair students, and blindfold one student in each pair. Ask blindfolded students to remain seated. Put all the rock samples in a pile, and have the students without blindfolds each choose one rock and take it to their partner. Have the blindfolded students feel their rocks. (No peeking!) Ask them to feel for shape, size, weight, and texture. When done, ask them to hand the rocks back to their partners, who return the rocks to the pile. When all rocks are returned, have blindfolded students remove their blindfolds and each try to determine which rock they felt. Ask how they recognized their rocks. Discuss that geologists distinguish kinds of rock by asking similar questions: How heavy is it? Is it hard or soft? How does it break? What color is it? Have partners switch roles and repeat the activity.

4) Play the Rock Type Relay. Divide students into two relay teams. Place a pile of rocks 25 feet away from a starting line. Explain that you will call out the name of a rock, and that the first student in each team must run, pick up a sample of that kind of rock, and run back to her team. Teammates must look at the selected rock and give a thumbs-up or thumbs-down. The runner then runs and replaces the rock in the pile, or selects a new rock if the first choice was incorrect. You may choose to keep score by awarding a point to the team that selects a correct rock first.

STATION 1

STATION TWO

Erosion in action

Objectives

Students will be able to:

- Describe erosion and its effects on rocks.
- Predict that sandstone will erode faster than granite, and explain why.

Materials

- **The Sandstone Rock Cycle** poster that highlights *erodes*
- Sandstone and granite rock samples
- Water squirt bottle
- Extra water

Time

- 30 minutes

PROCEDURE

1) Discuss **The Sandstone Rock Cycle** poster. Explain that *erosion* is the wearing down or weathering of the rocks around us. Take a short hike on the sandstone, showing and/or asking students to find examples of erosion of the sandstone. Find a crack in the sandstone and discuss how water might get into the crack. Ask students if they've ever put a can of pop or water bottle in the freezer and forgotten it. What happened? Explain that the same thing happens to water in the cracks on winter nights. Like the pop or water bottle, the water expands when it freezes, and when it does so it breaks grains of sand off of the sandstone.

2) Return to a circle and hand out rock samples of granite and sandstone. Ask students to predict which rocks would erode faster. Ask how they decided on their predictions, emphasizing that softer rocks erode most rapidly. Have students put rocks into two piles: *hard* and *soft*. Distinguish between *soft* and *smooth*.

3) Explain to students that they are going to investigate two forces that cause erosion to see which is more important, or the fastest eroder. The two forces are *water* and *wind*. Ask for predictions. Have students work together to make one mountain out of sand. If the sand is moist, have the students sprinkle lighter, drier sand on top. Explain that this is a model of the sandstone hills around us, though it is really sand, not sandstone.

4) To test the power of wind erosion, have students take turns blowing on the sand pile, watching to see how much sand blows. To test the power of water erosion, ask the students to count to four as you squirt the sand hill, then give each student a four-second turn to squirt. Encourage observations, and discuss results and the conclusion that water erodes the model more quickly than wind does.

5) Using the damp sand, demonstrate the process of arch formation, emphasizing the importance of water. Then have students build their own arches and other erosional features. Emphasize that erosion takes a long time, and that they are really speeding up the hands of geologic time!

EVALUATION

Ask students to draw a form of erosion in action (e.g., wind blowing sand or water carrying pebbles).

Objectives

Students will be able to:

- Name at least one difference between soils from the desert and soils from the mountains.
- Explain two roles of cryptobiotic soil crusts.
- Name two places to walk in order to avoid stepping on cryptobiotic soil.

Materials

- **The Sandstone Rock Cycle** poster that highlights *sand*
- Potting soil or mountain soil in a bucket
- Sand in a bucket
- Crypto puppet (a brown sock puppet with button eyes and a brown lump of carpet padding or something spongy and crusty-feeling that resembles a bump of cryptobiotic soil)
- Small poster that lists four functions of cryptobiotic soil (It holds the sand in place and prevents erosion, soaks up and holds water like a sponge, provides nutrients or fertilizer for other plants, and provides protected places for seeds to grow.)
- Crypto mat (a 6'x 3' piece of carpet padding with several 1"-2" tall lumps of brown or black carpet padding glued onto it)

Time

- 30 minutes

STATION THREE

Is it sand or soil?

PROCEDURE

1) Show and discuss **The Sandstone Rock Cycle** poster. Discuss sand, what colors it can be, where it comes from, if it moves, and how it moves. Model examples of observations of an object such as a hat. Then ask the students to touch and look at the mountain soil in the bucket, and have them each make one observation about it. Exchange buckets, and have students do the same with the sand. Then ask them to use their eyes and compare the two buckets of soil. Emphasize that the dark organic material (nutrients or fertilizer) in the mountain soil makes it easier for plants to grow.

2) Introduce the crypto puppet to students. Have the puppet tell students about the roles of cryptobiotic soil, referring to the poster. Then have the puppet tell the students that there's one thing that all crust fears: being crushed. Tell students that you are going to go on a hike to look for cryptos. Discuss the three good places to walk to avoid stepping on cryptos: on trails or roads, on slickrock, or in washes. Go on a hike. Point out older and younger cryptobiotic soil crusts. Have students lie belly-down on the slickrock adjacent to a crypto island and look closely at the cryptos. Ask them to point to a good landing place for a seed, where it wouldn't be blown away. If possible, show students what the tiny hairs (cyanobacteria sheaths) of cryptos look like.

3) Return to the starting area, and have the students take turns tiptoeing across the crypto mat, trying to avoid stepping on any of the crypto bumps. Review the roles of cryptobiotic soil crusts, and the three best places to walk to avoid busting the crust.

EVALUATION

Show students scenes from mountains and deserts, and have them distinguish which pictures are from each environment. Have students describe the differences between the soils they would expect to find in the two environments.

STATION 3

STATION FOUR

Making sandstone

NOTE

Hide the **Sandstone Ingredient** cards before students arrive.

PROCEDURE

1) Discuss **The Sandstone Rock Cycle** poster. Tell students that they will be exploring what it takes for sand to harden into sandstone, and will have a chance to make some sandstone.

2) Put on the apron as you discuss the concepts of *recipes* and *ingredients*. Show students the **Sandstone Recipe Card**. Ask if they want to go on a treasure hunt to find the missing **Ingredients** for making sandstone. Ask students to walk fast, but not to run. Read the first clue card, which will lead students to the *sand* card. Have students read *sand* together. Place the card on the **Sandstone Recipe Card**. Continue in the same manner, next finding *pressure*, then *water*, and finally *time*. Demonstrate the meaning of pressure by having students (and adults) place hands on top of each other's in one tall pile. Ask if the hands near the bottom feel any pressure.

3) Tell students it is time to try to make some sandstone. Go to an area of wash sand and have each student make a personal pile of sand. Then have students apply pressure to their sand by stomping on it. Squirt each student's sand pile with water. Have them continue to stomp as you talk about the water trickling between the sand grains and cementing them together. Then tell them they just need to add time by continuing to apply pressure for 5,000 years. Ask if they would get too bored before then, and have them realize they won't even live that long.

4) Tell students we can't make sandstone the way that the earth makes it, but we can make a model of it using a secret *time ingredient* called *plaster of paris*. Pour some plaster of paris into a plastic container and have each student add a pinch of sand to it. Have them each take a turn stirring, then add water and food coloring. Make the mixture thick enough that it will be dry by the time the next group arrives. Each group will make a layer of a different color in the one container. Students enjoy taking their creation back to their classroom.

5) Teach and practice the *Sandstone Recipe Rhyme*: "Sand, pressure, water and time; that's the sandstone recipe rhyme." Teach hand motions to go with the rhyme, moving fingers for "sand," pushing hands down for "pressure," making fish movement motions with hands together for "water," pointing to wrist for "time," and marching in place with arms swinging during "that's the sandstone recipe rhyme."

OBJECTIVES

Students will be able to:
- Name the four sandstone "ingredients."
- Describe how sandstone forms.

MATERIALS

- **The Sandstone Rock Cycle** poster that highlights *hardens*
- Apron
- **Sandstone Recipe Card**
- **Sandstone Ingredients**
- Clue cards
- Clear plastic containers
- Plaster of paris
- Water
- Food coloring

TIME

- 30 minutes

STATION 4

SANDSTONE RECIPE CARD

Recipe For Sandstone

1.

2.

3.

4.

SANDSTONE INGREDIENTS

Copy onto tagboard, cut apart, and apply velcro or other sticky substance to back of each.

SAND

PRESSURE

WATER

TIME

Objectives

Students will be able to:

- Explain in their own words the sandstone rock cycle.
- Distinguish soft rocks from harder rocks.
- Distinguish sandstone from other kinds of rock.

Materials

- **The Sandstone Rock Cycle** poster with a mini-shelf attached under each of the four words, for each class
- Four bags of rocks, labeled *sandstone, erodes, sand, and hardens* (All contain just sandstone except the sandstone bag, which contains other rock types as well.)
- A few paper plates

Time

- 30 minutes

POST-TRIP

POST-TRIP ACTIVITY

Sandstone rock cycle revisited

PROCEDURE

1) Show students **The Sandstone Rock Cycle** poster with mini-shelves, and have them tell you about the cycle. Review the field trip with students.

2) Divide students into four groups with one paper bag per group. Give the following instructions to the different groups:

Sandstone group should divide their rocks into two groups, sandstone and non-sandstone. Then they are to select their favorite piece of sandstone.

Erodes group is to determine which of their rocks is the softest.

Sand group should make sand by rubbing pieces of sandstone together, over the paper plates.

Hardens group is to determine which of their rocks is the hardest, by scratching the rocks with their fingernails.

3) When all the groups have completed their assignment, discuss their rock selections and success in making sand.

4) Go over the **Sandstone Rock Cycle** one more time, placing the three selected rocks and some sand on the corresponding mini-shelves attached to the poster. Leave the poster for display in the classroom.

EVALUATION

Discuss the sandstone rock cycle with students to clarify and check comprehension.

Have students create their own rock cycle posters.

Ask the students to imagine they are a rock going through the sandstone rock cycle. Have them dramatize the sandstone rock cycle.

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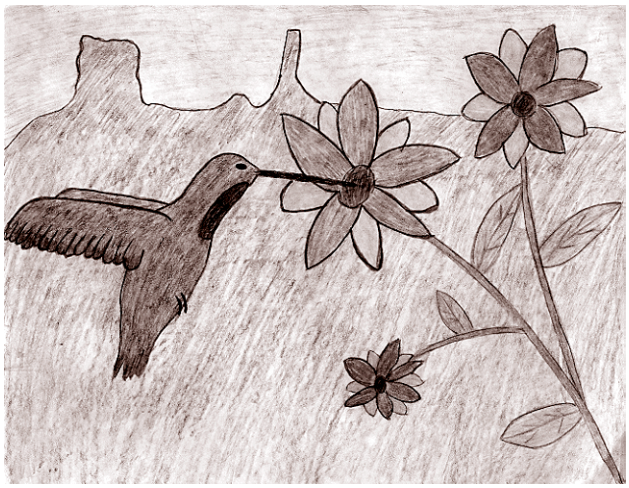
Spring Changes



CAITLIN LANGE

Outline

Theme
Plants and animals respond to changes in the seasons in unique and fascinating ways.

Utah State Science Core Curriculum
Topic: Changes in Plants and Animals
Standard [3020-01]
Students will:
- Compare changes and adaptations of plants and animals.
- Identify and compare changes plants and animals make that are related to the seasons.
- Compare ways that animals care for their young.
- Observe and describe how plants and animals change during their lives.
- Relate the structure of seeds to the ways they are dispersed.

Suggested Field Trip Locations
Courthouse Wash in Arches National Park, or anywhere with early to mid-spring growth, pond or stream for floating seeds (for Station #2), at least a few insects out (for Station #3), and some insect galls (for Station #4). If one of these elements is missing, the corresponding station can be omitted or altered. This is a spring field trip.

Background

Plants sprout from seeds, grow, and produce flowers, which, if pollinated, produce more seeds. Plants need sun, soil (and minerals) and water in order to be able to make their own food and grow. Insects seeking nectar and inadvertently moving pollen from one flower to another pollinate most flowers. Hummingbirds or bats pollinate some flowers. Coniferous trees and some other flowers rely on wind to distribute pollen.

DAMIAN FAGAN

Chrysalis of the mourning cloak butterfly.

If all seeds from every plant dropped straight down and sprouted, there would be overcrowding and no way for an individual plant to spread its genes over a larger area. But seeds are adapted to disperse from the parent plant. Lightweight, winged or cottony seeds are usually dispersed by wind. Thorny or stickery seeds usually disperse by hitchhiking on animals. Seeds of some plants that commonly live near water are light enough that they disperse by floating on water. Other seeds are encased in tasty fruits, and are commonly dispersed by animals that eat them. The trip through the animals' digestive systems and subsequent deposits provide fertilizer as well.

Insects are an extremely diverse group of animals. Their generally small size allows them to live in many places where larger animals couldn't. They have exoskeletons, six legs, and three body parts. Most have two pairs of wings, though flies have one pair, and some insects have no wings at all. Wings are only found in adult insects. Most insects have a pair of some type of antennae. These and the tiny hairs sticking out of insect exoskeletons help the insects to feel, smell, and in some cases, hear. A simple heart pumps insect blood through its body cavities, distributing dissolved food and removing wastes. The blood doesn't carry oxygen, so it isn't red.

Insects may have one of two types of life cycles. Insects going through incomplete metamorphosis have three stages: egg, nymph, and adult. Nymphs often look like miniature adults, such as in grasshoppers, cockroaches, and aphids. But some nymphs live in the water and look different than the adults. Examples include damselflies, dragonflies, and mayflies. Insects going through complete metamorphosis have four life cycle stages: egg, larva, pupa, and adult. Examples are butterflies, moths, flies, ants, wasps, and beetles. Larvae look completely different than their adult forms. Some larvae are aquatic and others are land-dwellers. A cocoon is a pupal case for a moth. A chrysalis is a pupal case for a butterfly.

Galls are temporary homes for some insects. They form when an insect chews on and injects a chemical into a plant, causing a swelling. Each species of gall-making insect has its own special species of plant that it must choose, or its specific gall will not form. The variety of sizes and shapes of galls is impressive. Oak apples, bumps and lumps on hackberries, swellings on cottonwoods, cottony balls on rabbitbrush, and cone-like growths on Utah juniper are all types of galls, each created by one insect species. Each type of gall has its own story, but many house and feed a single larva and pupa of a certain insect. The larva is commonly legless and blind, as its stage of the life cycle is contained within its food source, the gall's interior. Most gall-forming insects are small flies or wasps, but certain aphids, moths, beetles and psyllids are also gall-formers.

PRE-TRIP ACTIVITY

The seed story

PROCEDURE

1) Introduce the field trip location. Tell students that you have a puzzle that tells what they will be exploring on the field trip. Ask for volunteers and give one student at a time a puzzle piece with a piece of tape. Have them fit the pieces together on a blackboard or somewhere that all can see. Ask the whole class or a new volunteer to read the results: *Changes in Plants and Animals.* Probe for student knowledge of changes that animals and plants go through during their lives.

2) Set the stage for reading a book about some changes that plants go through. Remind students that illustrations often add to the information in a book. Show the book and ask students to raise their hands if they've read it before. Read the book *The Tiny Seed* aloud. Encourage students to "read" the illustrations, and pose questions while reading:

- What season is it? How do you know?
- Is it windy? What is happening to the leaves on the trees?
- Is it warm or cool? How do you know?

Summarize or wrap-up the book by discussing the purpose of seeds.

3) Ask students what season it is. Stress that weather can change quickly this time of year, and discuss the items that students need to bring on the field trip.

EXTENSION

Have students create seed collages from seed catalogs and other sources of seed pictures, or from wild seeds collected on a hike.

OBJECTIVES

Students will be able to:

- Name at least one example of changes that plants go through and one example of changes that animals go through during their life cycles.
- Identify the purpose of seeds in the plant life cycle.

MATERIALS

- Changes puzzle (Print *Changes in Plants and Animals* on a posterboard, then cut the posterboard into five or six "puzzle pieces.")
- Masking tape
- *The Tiny Seed* (Carle 1987)

TIME

- 30 minutes

PRE-TRIP

Objectives

Students will be able to:

- Describe the stages of a wildflower life cycle.
- Name the four seasons, and describe their influences on a wildflower life cycle.

Materials

- "Spring Defeats Winter" (Caduto and Bruchac 1988, 129-132)
- "Season Suite" (Caduto and Bruchac 1988, 132-133)
- Name tags (*sun, bee, wind, raincloud*)
- One-quart squirt bottle
- Extra water bottle
- Pint or quart plastic tub of flour

Time

- 30 minutes

STATION ONE

Season Suite

From Caduto and Bruchac 1988, 129-133

PROCEDURE

1) Read "Spring Defeats Winter" to students. Discuss the story, asking students if they wanted Old Man Winter to melt the warmth of Young Man Spring, which seasons are their favorites, and what causes the seasons. Ask students to identify the four seasons, and discuss the changes that occur during the seasons. Include discussion of temperature and day length changes, and launch into the subject of how plants change through the seasons. Be sure students know what stage the plants are currently in, and what season it is now.

2) Go on a brief search for signs of spring in the plants. Look at wildflowers or, if it's earlier, young, green sprouts of grasses, wildflowers, or shrubs. Relate these discoveries to the season.

3) Tell students they will be acting out a story of the changes that a wildflower goes through during the different seasons. Assign and explain parts, and set limits on the use of materials: The *sun* will radiate energy. The *raincloud* will give each flower two or three squirts with the spray bottle when it rains in the story. The bee will have a container of pollen (flour) to pollinate the flowers (with just a small *pinch* of flour). The rest of the students are annual wildflowers. Explain that annuals are plants that grow from a seed each year, and make new seeds by the end of the year. Discuss a few examples of plants that are annuals and plants that are not.

4) Rehearse the play "Season Suite" at least once. You may choose to rehearse it several times and then perform a final show for a parent or teacher, or you may choose to repeat the play a few times with students assuming different roles. Prompt students about what comes next as they perform.

EVALUATION

Interview students, asking them to describe the wildflower life cycle and the effect seasons have on the cycle.

Coordinate students in creating a classroom wildflower life cycle display, using construction paper or other materials.

STATION 1

STATION TWO

Blowin' in the wind

PROCEDURE

1) Discuss the environmental conditions that a seed has to live with in the high desert of southeastern Utah. Have students imagine the overcrowding there would be if all seeds dropped straight down from their parent plants. Describe seed dispersal as a plant adaptation. Explain that different types of seeds have adapted different ways to disperse.

2) To demonstrate wind dispersal, place a wind-dispersed seed in each student's hand, having students hold their hands tight until you give the word. On a signal have students open their palms, and either hold their palm up in the wind or blow on the seed (if there's no wind). Count the number of seeds on the parachute-like head of a dandelion. Ask students how the wind helps tumbleweeds disperse their seeds.

3) To demonstrate seed dispersal through *hitchhiking*, give each student a flannel cutout animal. Walk around the immediate area for a few minutes and have students catch seeds in the "fur" of their animals. Inspect and discuss the seeds that were caught (the best hitchhikers). Show examples of other seeds that disperse by hitchhiking.

4) To demonstrate water dispersal, move to the water's edge. Ask students to do a scientific investigation to answer the question: *Which seeds will float?* Hand each student a seed and have each observe the seed and predict whether it will sink or float. On a signal, have all the students drop their seeds in the water. Watch to see which seeds floated, and compare to predictions. Ask students what physical features helped seeds to float. Point out that scientists often work together as this group just has, in order to gather more observations or data to answer their questions.

5) Discuss another method of seed dispersal: passing through digestive systems of animals. Explain that this method provides not only transportation, but fertilizer as well. Review the ways that seeds disperse or read the story *How Seeds Travel.*

EVALUATION

In small groups, have students create stories of seed dispersal and act them out. Start by telling them a sample story, such as one of a coyote eating a seed and the seed later growing into a beautiful small tree near a stream.

OBJECTIVES

Students will be able to:
- Name three ways seeds are dispersed.
- State at least one benefit of seed dispersal.
- Respond to a scientific inquiry based on personal and group observations.

MATERIALS

- Felt animal cutouts
- A variety of seeds
- A bag of wind-dispersed seeds (dandelion, cottonwood, milkweed, etc.)
- (optional) *How Seeds Travel* (Overbeck 1982)

TIME

- 30 minutes

STATION 2

Objectives

Students will be able to:
- Describe the stages of complete metamorphosis in insects.
- Find insects, and recognize their life-cycle stage most of the time.

Materials

- **Complete Metamorphosis** puzzle (Copy **Complete Metamorphosis** onto tagboard and cut into approximately as many puzzle pieces as students in each group)
- Pictures of interesting insects in different stages (e.g., Emmel 1975)
- Copies of **Insect Bingo**
- Clipboards
- Pencils or crayons

Time

- 30 minutes

STATION THREE

Interesting insects

PROCEDURE

1) Hand one **Complete Metamorphosis** puzzle piece to each student (Lingelbach 1986, 122). Instruct students to place the pieces together. When the puzzle is complete, use it as a prop for going over the stages of complete metamorphosis. If students are familiar with the concept, keep the review brief, and discuss incomplete metamorphosis, too. If less familiar, spend more time introducing complete metamorphosis.

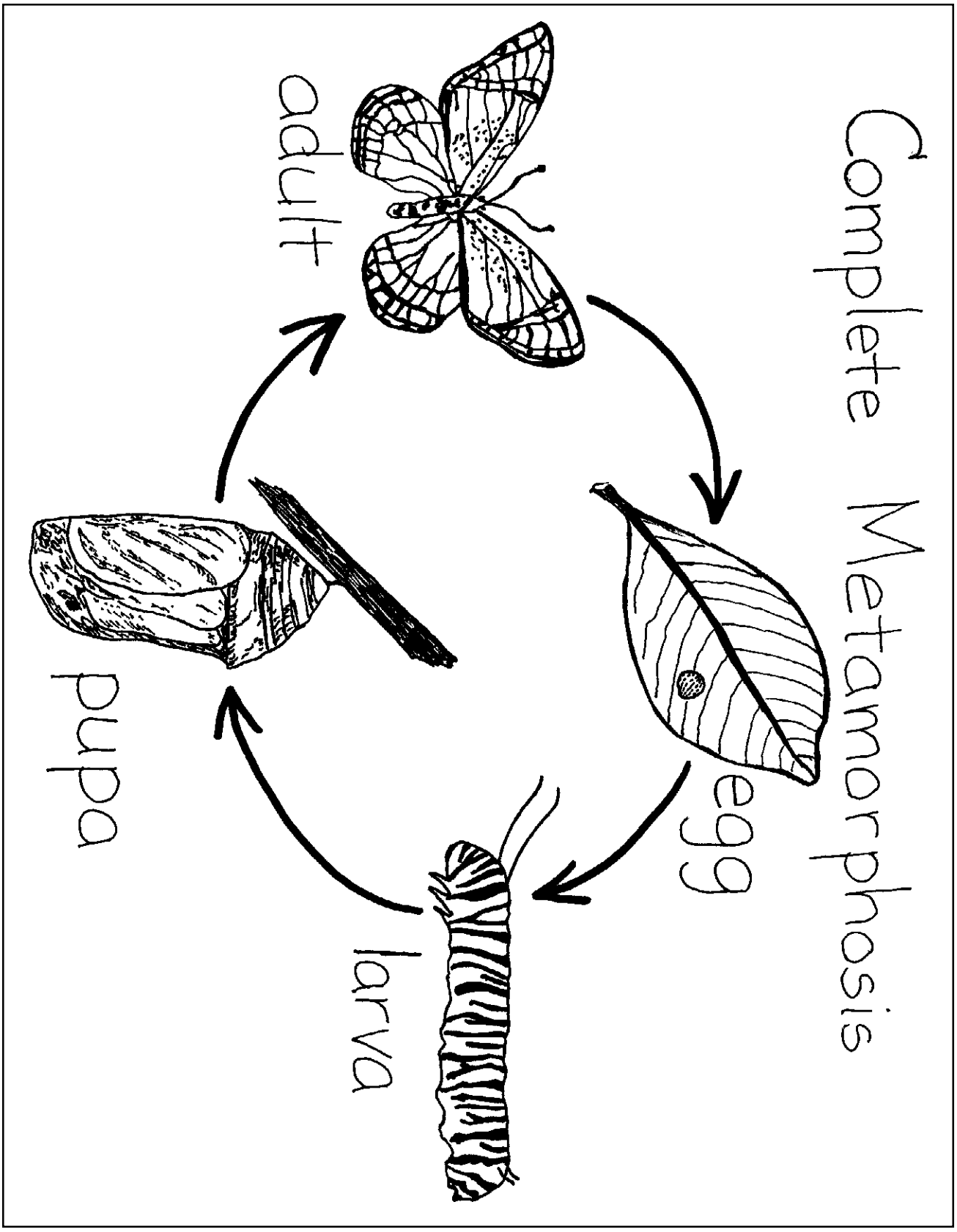
2) Show pictures of insects in various stages. Also show pictures of interesting insects with special adaptations such as bright colors or camouflage, and discuss how the adaptations might help the insects.

3) Show students an **Insect Bingo** sheet, and explain that they will be looking for as many of the things on the card as they can find. Instruct students to help each other out by showing each other their discoveries, and ask them to look, but not collect, the insects. Explain that while most insects are not harmful, a few do bite or sting. When they see something listed on the card, they should mark it on their sheet. Tell them they may find a partner to work with, then hand out clipboards and sheets. Briefly go over the sheets, giving explanations of a few of the terms that might not be familiar to all students. Set boundaries of hunt area, or keep the group fairly close together.

4) Save a few minutes to reunite the group and have each student or pair choose one of their discoveries to describe. As an insect is described, ask which stage of metamorphosis it represents. Add a quick review of the stages of metamorphosis if there is time.

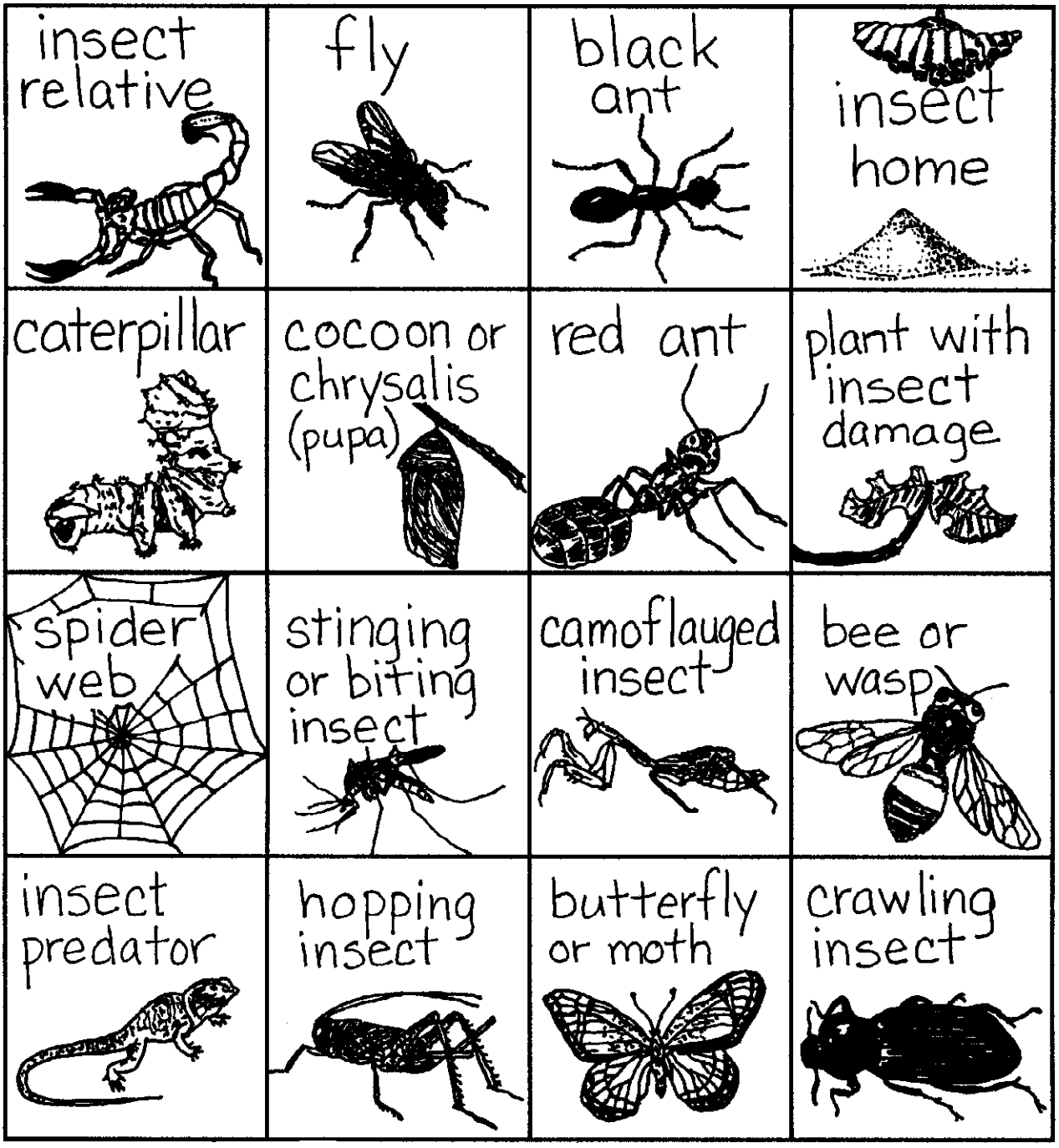
DAMIAN FAGAN

STATION 3


Complete Metamorphosis
egg
larva
pupa
adult

INSECT BINGO

Adapted from Incredible Insects, *1984, 1989. 32*



STATION FOUR

What gall!

NOTE

Before the station, put a few of one type of gall such as the cottony rabbitbrush gall into bug boxes. Cut one gall open so students can view the larva inside.

PROCEDURE

1) Have students examine the galls in the bug magnifying boxes, noticing color, shape, size, texture, where it grows, and if and where there are holes in the galls. Then have students examine the pre-cut gall, with an insect in its grub-like larval stage. Have them look, too, for how much of the gall's interior has been eaten by the host larva. Students may see insect invaders or invasion holes in a gall. Tell them the story of galls, including the following points:

- Galls are temporary homes for insects;
- Galls form when an insect chews on and injects a chemical into the plant, causing a swelling;
- Gall-making insects each have their own special species of plant that they must choose, or the gall will not form;
- Each kind of gall insect causes its own specific type of gall to form.

Show students a variety of types of galls.

2) Review **Complete Metamorphosis** stages, using the poster. Tell students that a gall is a source of food, usually for the larval stage of an insect. Use the analogy of a child stuck in a gingerbread house in a very cold, snowy place for the winter, eating the inside of the house for food and keeping warm in the house.

3) Go on a hike and look for galls growing on different plants. On the return, ask children to silently count how many galls they see on the way back to the station site. (This works well where there are a great number of galls this time of year, such as some areas of thick rabbitbrush, coyote willow, big sagebrush, or Utah juniper.)

4) As a review activity, read **Gall Fantasy**, having students follow the guided imagery.

OBJECTIVES

Students will be able to:
- Identify galls and see differences between different types of galls.
- Describe the stages of complete metamorphosis.

MATERIALS

- **Complete Metamorphosis** poster (See Station #3 for template.)
- Variety of galls
- Bug magnifying boxes
- **Gall Fantasy** (Lingelbach 1986, 87)

TIME

- 30 minutes

STATION 4

GALL FANTASY

You are about to become tiny, defenseless creatures. Please, very quietly, get your jackets and find a place where you can be protected, but where you can easily hear my voice. Crouch, become as small as you can, put your jacket over your head and be very silent. Close your eyes.

It is fall now, the days are growing shorter and nights are cold. But you can't see the daylight nor feel the chill; you are snug in your gall home. You can eat, your food is all around you, warm and dry, you need only reach out to the nearest wall for food. *Eat*, rest and *eat* again.

The leaves have fallen, beaten to the ground by gusty winds and pelting rain. You are safe and dry in your gall home. But you are alone and it is dark.

Autumn turns to winter. The snows have come, the ponds are iced, winter buries food for creatures like yourselves.

The sun is higher now, owls are nesting, streams are thawing, and you are growing bigger. Warmth, snow melting, sap running. You sleep your final sleep, deep inside your private gall. The time has come for you to change.

The days are growing longer and warmer. Grass is green and flowers bloom. Your gall home is brown and dry. You feel an urge to stretch and move, stretch and move, and suddenly you are out of your gall, standing tall, soaking in the sunlight, drying your wings. You are an adult.

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POST-TRIP ACTIVITY

Cycles, cycles, cycles

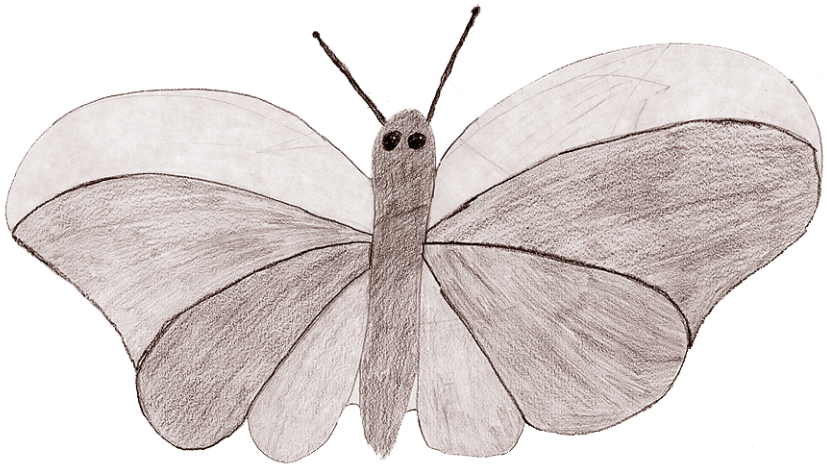
PROCEDURE

1) Discuss the field trip with students, emphasizing the various life cycles explored.

2) Read *The Reason for a Flower* to the students.

3) Review the stages in the life cycle of a flower. Have students as a group act out the cycle as they did in Season Suite.

4) Review the stages of insect **Complete Metamorphosis**. Briefly teach a position or action for each of the four stages. Then, hold up one Insect Metamorphosis stage card at a time, and have students quickly assume the correlating position or action. Vary the order and increase your speed. You may have students call out the next stage after the one represented on the card, thus working back into the sequence of the stages.



LACEY COX

OBJECTIVES

Students will be able to:
- Describe the life cycle of a flower.
- Name the four insect stages of complete metamorphosis.

MATERIALS

- *The Reason for a Flower* (Heller 1983)
- **Complete Metamorphosis** poster (See Station #3 for a template.)
- Insect Metamorphosis stage cards (5"x 8" cards with a name of an insect stage on each)

TIME

- 25 minutes

POST-TRIP

References and Resources

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